REMARKS

The foregoing amendment amends claims 1-11. Pending in the application are claims 1-11, of which claim 1 is independent. The following comments address all stated objections and rejections and place the presently pending claims, as identified above, in condition for allowance.

Claims 1-11 are amended to remove the words "phosphoric acid" from the term "phosphoric acid fuel cell" to clarify that the electrolyte is not limited to phosphoric acid. Claim 1 is also amended to specify that the hydrogen containing gas is supplied from a hydrogen storage source, as shown in Figure 3 and described on page 12, lines 9-16 and page 13, lines 12-25 of the specification. *No new matter has been added.*

The Claimed Invention

The present invention is directed to a method of operating a fuel cell which comprises an anode electrode, a cathode electrode and an electrolyte layer including a basic polymer matrix impregnated with acidic liquid electrolyte. In the fuel cell system of the present invention, hydrogen-containing gas is supplied to the anode electrode from a hydrogen storage source. The hydrogen in the hydrogen-containing gas is ionized on the anode electrode, as illustrated by reaction formula (A) on page 2, line 10. The resulting hydrogen ion moves toward the cathode electrode via the electrolyte layer. The electron after, being utilized by a circuit, also arrives at the cathode electrode. Oxygen-containing gas is supplied to the cathode electrode at a higher pressure than the hydrogen-containing gas. At the cathode electrode, the hydrogen ion and electron react with oxygen in the oxygen-containing gas to produce water, as illustrated by reaction formula (B) on page 2, lines 23. The pressure on the cathode electrode is higher than the pressure on the anode electrode to facilitate the reaction represented by formula (B), which would otherwise be much slower compared to the reaction of formula (A). The resulting increase in the velocity of the reaction formula (B), which is the rate-determining step in the overall fuel cell reaction, *vastly improves the energy conversion ratio* of the fuel cell and *increases power generation.*

The use of an electrolyte layer including a matrix composed of basic polymer impregnated with acidic liquid electrolyte further enhances the operation of the fuel cell. The claimed electrolyte layer has a high mechanical strength for withstanding the pressure differential between the cathode electrode and the anode electrode to prevent damage of the electrolyte layer. The claimed electrolyte layer also employs a matrix and electrolyte that are attracted to one another to retain and prevent leakage of the liquid electrolyte.

Objections to the Disclosure

Regarding the objection to the disclosure on page 8, Applicants respectfully point out that page 8, lines 1-7 of the specification refer to Figure 2, not Figure 1 as stated by the Examiner. Reconsideration and withdrawal of the objection is respectfully requested.

35 U.S.C. 112 Rejections

Regarding the rejection of claims 3, 7 and 10 for being indefinite, Applicants have amended the claims to remove the words "phosphoric acid" from the term "phosphoric acid fuel cell" in claims 1-11 to clarify that the electrolyte is not limited to phosphoric acid. Applicants respectfully request reconsideration and withdrawal of the rejection.

35 U.S.C. 103(a) rejections

In the Office Action, the Examiner rejects claims 1-11 as being obvious over the Maru reference in view of the Savinell reference. Applicants respectfully traverse the rejection and submit that the presently pending claims, as identified above, are patentable over the cited prior art.

The Maru reference describes a fuel cell system, including a reforming system, in which the speed of the reforming reaction is increased to improve the overall efficiency of the system. The fuel cell system of Maru is capable of high pressure operation, and the pressure of the oxidant gas is higher than the pressure of the fuel gas to enhance the reforming reaction (not the reforming rate). The Maru reference teaches that the use of a lower pressure fuel gas permits the use of lower pressure steam in the reforming process, which allows the temperature of the exhaust oxidant gas used to produce the steam to also be lower, thereby extending the life of the

fuel cell. The use of a lower pressure fuel gas in Maru also allows the reformation reaction to be performed at a lower pressure, which increases efficiency.

In Maru, fuel gas is supplied to the fuel cell from a reformer, which processes a supply of fuel and steam to produce the fuel gas. The Maru reference does not relate to the type of fuel cell system of the present invention, in which the hydrogen-containing gas is supplied from a hydrogen storage source, set forth in claim 1. Because the claimed invention requires a hydrogen-containing gas to be supplied from a hydrogen storage source, rather than a reformer, the claimed method of operating a fuel cell greatly differs from the fuel cell system of Maru. The Maru reference also does not teach or suggest operating a fuel cell in the claimed manner to increase the *reaction rate* of the fuel cell, a significant advantage of the claimed invention.

Furthermore, as recognized by the Examiner, the Maru reference does not teach or suggest that the electrolyte layer of the fuel cell includes a matrix composed of a basic polymer impregnated with acidic liquid electrolyte, as also required by claim 1. Rather, the fuel cell includes an electrolyte matrix comprising a layer of silicon carbide and a layer of carbon.

The Examiner looks to the Savinell reference to make up for the deficiency of the Maru reference in determining that the claims are obvious. The Savinell reference describes a solid polymer electrolyte for a fuel cell comprising a basic polymer membrane (such as polybenzimidazole) that is impregnated with phosphoric acid or sulfuric acid. However, the Savinell reference does not teach or suggest a pressure difference between the anode electrode and the cathode electrode for improving the efficiency of the fuel system, or that a hydrogen-containing gas is supplied from a hydrogen storage source, as required by the claimed invention.

Applicants submit that there is no motivation to combine the references in order to render the claims obvious. In determining whether a case of *prima facie* obviousness exists, it is necessary to ascertain whether the prior art teachings would appear to be sufficient to one of ordinary skill in the art to suggest making the claimed substitution or other modification. The prior art must provide the motivation to make a change to its own teachings to arrive at the

invention under rejection. That is, it is not sufficient that the prior ***could be*** so modified; instead the prior art must teach or suggest that the prior art ***should be*** so modified.

Applicants respectfully submit that the Examiner does not adequately and sufficiently state what his motivation is for combining the teachings of the Savinell reference with the teachings of the Maru reference to render the claims obvious. The Examiner merely states that because the electrolytes described in Savinell are stable, conductive and overcome problems with catalyst stability, it would be obvious to use the polymer membrane of Savinell in the Maru reference.

Notwithstanding this statement, Applicants respectfully disagree with the proposed combination. There is no teaching in either reference that would provide motivation or a suggestion to combine the two references to render the claimed invention obvious. The Savinell reference and the Maru reference do not seek to solve the same problems that are overcome by the claimed invention. In the present invention, the pressure on the cathode electrode is high in comparison with the pressure of the anode electrode to facilitate the reaction (B) between the hydrogen ion, the electron and oxygen in the oxygen-containing gas to produce water. Neither the Maru reference nor the Savinell reference teaches or suggests facilitating the reaction (B) by creating a pressure differential.

As described in Applicants' specification, the present invention includes a matrix that can withstand the pressure differential between the cathode electrode and the anode electrode to prevent damage of the electrolyte layer and prevent leakage of the liquid electrolyte. The claimed matrix is specifically selected for the ability to retain liquid electrolyte and for its high mechanical strength. The Savinell reference describes a solid polymer electrolyte membrane for use in a fuel cell that overcomes problems with stability and conductivity. Neither the Savinell reference nor the Maru reference teaches or suggests a need for preventing leakage of liquid electrolyte, which the present invention seeks to prevent. The Savinell reference also does not indicate the need for a matrix having a high mechanical strength.

The prior art does not teach or suggest the claimed method of operating a fuel cell, where hydrogen-containing gas is supplied from a hydrogen storage source. Furthermore, because there is no motivation in either reference for one of ordinary skill in the art to use the electrolyte membrane described in Savinell in the fuel cell of Maru, Applicants submit that the combination of references is in error. Therefore, the claimed method of operating a fuel cell is patentable over the Maru reference and the Savinell reference.

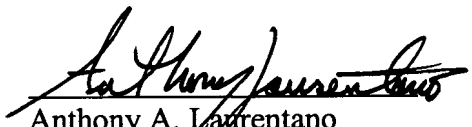
CONCLUSION

For the foregoing reasons, Applicants submit that the presently pending claims, as identified above are patentable over the cited prior art. As such, Applicants respectfully request that the Examiner's objections and rejections be reconsidered and withdrawn and that the application be passed to allowance.

If there are any remaining issues, an opportunity for an interview is requested prior to the issuance of another Office Action. If the above response is not deemed to place this case in condition for allowance, the Examiner is urged to call the Applicants' representative at the telephone number listed below.

Respectfully submitted,

LAHIVE & COCKFIELD, LLP



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